Nopal I Uranium Deposit as an Analogue for Radionuclide Transport

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RESEARCH OBJECTIVES

The primary objective of this collaborative analogue study is to develop conceptual and numerical models for radionuclide transport at the Nopal I uranium (U) mine in the Peña Blanca district, Chihuahua, Mexico. These models can be used to evaluate the Yucca Mountain Total System Performance Assessment (TSPA) model. The models will be constrained through field and laboratory studies of the geology, geochemistry, and hydrology of the Nopal I system.

APPROACH

The Nopal I deposit has a number of characteristics that are similar to those of the planned high-level waste repository at Yucca Mountain, characteristics that make it a good analogue for evaluating the long-term transport of radionuclides. Both areas have thick (>200 m) unsaturated zones, are located in Basin and Range horst structures comprised of Tertiary rhyolitic ash-flow tuffs overlying limestones, and have semi-arid to arid climates. In addition, the secondary uranium mineral assembly at Nopal I is similar to the fuel rod alteration assemblage predicted to develop within a geologic repository.

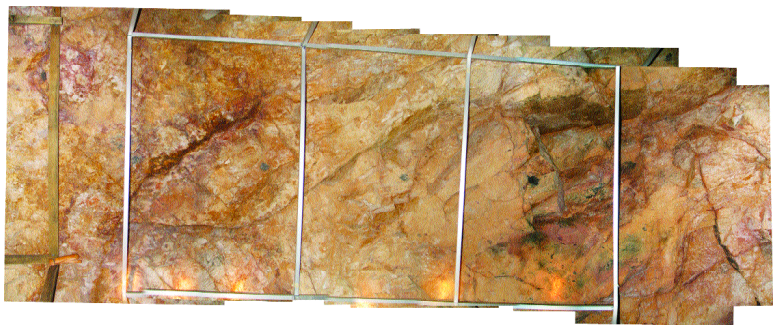

Figure 1. Photomosaic of back (ceiling) of +00 adit of Nopal I mine. Seepage occurs preferentially along the iron stained fracture within the left frame. Metal frame (12′ by 5′) is part of a seepage collection system.

This study consists of eight different subprojects that are being conducted jointly by researchers at Berkeley Lab, Los Alamos National Laboratory, University of Tennessee-Knoxville, University of Texas-El Paso, the University of Southern California, the Instituto de Ecología, and the Autonomous University of Chihuahua. Berkeley Lab is a primary participant in four of these research areas: (1) characterization of rock and hydrologic properties; (2) adit seepage studies; (3) characterization of the role of colloids in radionuclide transport; and (4) development of numerical flow and transport models.

ACCOMPLISHMENTS

Work completed thus far includes the characterization of the stratigraphy for the Nopal I area, collection of representative samples of each unit from the PB-1 core for rock-property measurements, and installation of a seepage collection system and characterization of fractures within the +00 adit (Figure 1). To develop a hydrologic flow model for the region, we have also collected water samples from wells, springs, and the adit, reviewed regional hydrologic data, and conducted water table measurements in wells in the Nopal I area. Future work includes refining the hydrologic model, completing rock-property analyses, conducting seepage studies within the adit, and developing conceptual and numerical models for fluid flow, colloids, and radionuclide transport.

SIGNIFICANCE OF FINDINGS

Initial results from the hydrologic study indicate that the primary subsurface flow direction is towards the Laguna El Cuervo basin to the east. Seepage within the adit appears to be focused along specific faults and fractures, suggesting that flow through the welded ash-flow tuffs is dominated by fracture flow. The concentrations of U in water collected from wells immediately adjacent to the deposit are significantly higher than those recorded in regional water wells (< 10 ppb), but these concentrations have steadily declined with time, suggesting that the initial elevated values (up to >10 ppm) were caused by contamination resulting from drilling.

RELATED PUBLICATIONS

Dobson, P.F., P.C. Goodell, M. Fayek, F. Melchor, M.T. Murrell, A. Simmons, I.A. Reyes-Cortés, R. de la Garza, and R.D. Oliver, Stratigraphy of the PB-1 well, Nopal I uranium deposit, Sierra Peña Blanca, Chihuahua, Mexico. Geological Society of America, Abstracts with Programs, 37 (in press), 2005.

Rodríguez-Pineda, J.A., P. Goodell, P.F. Dobson, J. Walton, R.D. Oliver, R. de la Garza, and S. Harder, Regional hydrology of the Nopal I site, Sierra de Peña Blanca, Chihuahua, Mexico. Geological Society of America, Abstracts with Programs, 37 (in press), 2005.

ACKNOWLEDGMENTS

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